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THE EFFECT OF VARIOUS PHYSICAL THERAPEUTIC MEASURES ON CAPILLARY RESISTANCE

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THE EFFECT OF VARIOUS PHYSICAL THERAPEUTIC MEASURES ON CAPILLARY RESISTANCE

In the year 1874, Auspitz described the appearance of petechia on the forearm which developed in certain diseases after applying a tourniquet to the upper arm. This observation was quickly forgotten and then rediscovered by Rumpel in 1909 among scarlet fever patients. Leede, two years later, developed a quantitative clinical test on the basis of this observation. Since that time it has been known as the Rumpel-Leede Phenomenon. Many modifications of Leede's method have been described in the literature: Hess, 1914; Stephan, 1920; Walterhöfer, 1925; Goethlin, 1931; Bexelius, 1931.

Hess in 1907 described a method whereby he applied a suction locally instead of producing congestion by pressure. Although this method has very definite advantages it was not employed clinically until the work of da Silva Mello in 1929. In the following years many authors used various modifications: Borbely, 1930; Mengler, 1930; Wiener, 1931; Hahngren-Lytthens, 1933 and Dalldorf, 1933. The variables in the different methods are to be found in the duration and intensity of the employed suction force and in the number of petechia required for a positive result. The reader can find a detailed review of these methods in the excellent publications by Franke, 1943, and Frischknecht, 1945.(1)

There are two reasons for the replacement of the original pressure method by the reduced pressure method. Firstly, the latter is not limited to the extremities, but can be employed anywhere on the body surface. The second, and most important point, is that it has a much wider range. In the congestive

method the pressure in the capillaries can not be raised above the arterial blood pressure, i.e., ca. 120 mm Hg. However, by employing suction a pressure of more than 700 mm Hg can be exerted. We can evoke petechia formation in ailing and in healthy individuals without exceeding 400 mm Hg. This fact is of great significance because it allows us to measure quantitatively slig departures from the norm.

The determination of the capillary resistance (C.R.) is the simplest and most widely used method for observing changes in cutaneous capillary permeability for erythrocytes. The method was described by Franke (2) in 1943. The principle is as follows: A definite amount of suction is applied to a circumscribed area of skin for one (1) minute. The suction is produced by means of a glass bell, 2 cm. in diameter. The C. R. is defined as tha intensity of suction force, of a one (1) minute duration, necess to produce 1-4 petechia in the area under the central portion of the glass bell. The C. R. is, therefore, a means of measuring the cutaneous capillary permeability for erythrocytes. Although it hasn't been experimentally proven as yet, various experiments indicate a corresponding correlation for the plasma permeability of the capillaries. (2, 3, 4, 5.)

Since many individual extra-vascular factors, eg.g. density, elasticity and the coefficient of friction of the skin, etc., influence the C. R., no generally reliable normal values can be given. For these reasons changes, primarily in the C. R., in the course of diseases through physical effects and medication, are of interest. We briefly mention the changes in the C.R. found i the course of infectious deseases by Franke (2) and Koller and Diem, (4) and in haemorrhagic diathesis by Frischknecht. (7) Physical effects

like ultra-violet radiation[2], Roentgen-rays[8], and burns[2] influence the C. R. in typical fashion. A series of medicaments influence the C. R. characteristically: effect of Calcium[2,4], Antistin and Antergan[4,5], and Vitamin P.[9] The changes in the C. R. at high altitudes[5] and under climatic influences[10] are due to the influence of the vegetative nervous system on the capillaries. Wyss and Matti[11] found the same correlation with sympathico- and parasympathico-memetic substances. This was also found in bronchial asthmatics.[11]

We, in Physical Therapy, have mainly qualitative conceptions of the biological effect of our procedures on the circulatory system. Many of our clinical applications have solely an empirical basis. The simplicity and adaptability to our conditions makes the determination of the C. R. and ideal method for studying the quantitative effects of our procedures. In order to compile some further information in this field we have begun to study the effects of various physical therapeutic measures on the C. R.

The following pages give the Method, Results, and Conclusions of an experiment done at the University Physical Therapeutic Clinic on ten (10) volunteer persons, all in good health.

METHOD

Apparatus

To measure the C. R. we used the method of Wyss and Matti.[11] In principle it is identical to the already described method of Franke.[2] Wyss designed the apparatus, Capillary Resistometer[12] while at the Hallerianium, Bern, under Prof. A. von Muralt, and it is produced by the Firma H. Junghaus in Zurich.

The cutaneous temperature was measured with a Heidenwolf thermo electric skin thermometer.

Procedure

Ten healthy patients between the ages of 25 and 65 years were selected. Each patient was subjected to all the tests so that any comparisons made would be valid.

We mentioned previously that extra-vascular factors influence the C. R. Especially variable is the coefficient of friction of the skin.. A well lubricated skin is sucked considerably further into the glass bell than is a dry skin. In order to eliminate this variable we lubricated the edges of the glass bell with vaseline before each measurement.

C. R. can be measured anywhere on the skin, however, different regions show widely varying capillary resistances.[2.6] Measurements on corresponding localisations, i.e., a given area on the right and left forearm, give identical results. Since we deal primarily with extremities in physical therapy we selected the proximal 1/3 of the volar surface of the forearm, after determining that the C. R. was constant in this area.

Wyss and Matti[11] found that the C. R. has a daily rhythm; high in the morning, low at midday and high at night. The C. R.

varies as much as 30 mm. Hg during the day. For that reason, we tested each person at the same time of day throughout the series of tests.

Each test was conducted as follows:

We measured the C. R. and temperature (T) of both forearms before the treatment and immediately after the therapy. Ten (10) minutes later the C. R. and temperature of the treated forearm were again measured.

RESULTS

The C. R. of our ten (10) patients varied between 310 and 380 mm. Hg. Four of the ten had C. R. of 330 mm. Hg. The original C. R., that is, the C. R. before each test (two day interval between tests), and the C. R. after completion of the experiment was identical for the particular individual involved. In the composite chart (opposite page) are to be seen the changes in the C. R. and T. listed after the indicated treatment.

It was also observed that the C. R. was decreased considerably, 27.5 - 44 mm. Hg on the untreated corresponding localisation after short wave, Fango, and hot air therapy. We assumed that this was due to a reflex to the corresponding dermatome. In order to determine whether other factors were at work we decided, also, to measure the C. R. of another non-corresponding dermatome, for example, the umbilicus area. The C. R. in this region, before therapy, is almost 1/3 of that on the forearm, 110 - 135 mm. Hg. After treatment to the forearm we found decreases in the C. R. of the umbilicus area slightly less in absolute, but greater in relative value compared to those of the corresponding dermatome; the untreated forearm. This would indicate that some vasodilating, perhaps histamine, or histamine-like, substance was liberated from the treated area.

The changes in the C. R. in the various test-methods on the untreated arm are, in order of their effectiveness, as follows: hot air, short wave, Fango, micro wave, Sollux. The pronounced change caused by hot air was probably due to an overheating of the body. The heat (temperature) regulating center was stimulated and produced a strong vasodilation with the resulting decrease in the C. R.

For the sake of clarity it is necessary to be further acquainted with the works of H. Knoll, W. Wilbrandt and F. Wyss,(1) before continuing the discussion. A brief summary follows:

1. The result of a capillary fragility test depends on the difference in pressure inside and outside the blood capillaries.

2. It is assumed that changes of short duration in the capillary fragility, particularly under the influence of drugs affecting the circulation, do not, in general, mean a corresponding change in the mechanical properties of the capillary wall, but, rather, a change in capillary pressure.

   If the blood supply to the skin is changed by contraction or relaxation of the arteriolar muscles, the capillary pressure rises with vasodilation, and decreases with vasoconstriction. Simultaneous determinations of capillary fragility and skin temperature showed correspondingly that during the action of circulatory drugs the capillary fragility increases with increasing blood supply and vice versa. Drugs tested were, histamine, antistine, epinephrine. Average ΔC. R. pro 1° C. was 20 - 30 mm. Hg.

   If the skin temperature is changed by physical means, followed by reflex adaption of the blood supply to the skin, qualitatively the same correlation is obtained. Quantitatively, as to be expected, the change of capillary fragility with skin temperature is smaller; ΔC. R. pro 1° C. of 6 - 8 mm. Hg.

CONCLUSIONS and DISCUSSION

The C. R. was only slightly influenced by micro (radar) waves. Even though a hyperemia and a 2°C. temperature rise was produced a ΔC. R. pro 1° C. of only 11 mm. Hg was found. This change corresponds to those produced with purely physical means (ring perfusion) as seen in the work of H. Knoll, W. Wilbrandt and F. Wyss.(1)

The C. R. immediately after treatment and ten minutes later, on the treated arm, was greatly decreased by the other four methods; 61-90 mm. Hg in the former, and 42-86 mm. Hg in the latter. If we plot all the readings obtained immediately after therapy, against the temperature, we see that the C. R. is a function of the temperature and that the average Δ C. R. pro 1° C. is 20 mm. Hg (see graph #1).

A plot of the average C. R. readins for the different therapies obtained immediately after treatment and ten minutes later, shows that the C. R. is increased after ten minutes and that the obliquity of increase is inversely proportional to the initial decrease in the C. R., i. e., the greater the initial decrease in the C. R., the smaller is the increase in C. R. after ten minutes. (see graph #2).

In the discussion that follows we will confine ourselves to the effects on the C. R. produced on the treated forearm by short wave, Fango, Sollux and hot air therapies.

We have already mentioned that the Δ C. R. immediately after treatment is a function of the temperature (graph #1). Our findings (average initial Δ C. R. pro 1°C. of 20 mm. Hg) closely correspond to the changes produced by circulatory drugs, e. g. Histamine, (Δ C. R. pro 1°C. = 20-30 mm. Hg). This would indicate that besides a purely physical effect, our therapeutic measures induced an arteriolar vasodilation with a resultant increase in capillary pressure causing a decrease in the C. R.

We have previously shown that the Δ C. R. ten minutes after treatment was a function of the intensity of the immediate change on the C. R. (graph #2). If we compare the C. R.

THERAPY	PT.	TREATED FOREARM						UNTREATED FOREARM			
		C.R. PRE THERAPY	C.R. POST THERAPY	C.R. 10' POST THERAPY	T°C. PRE THERAPY	T°C. POST THERAPY	T°C. 10' POST THERAPY	C.R. PRE THERAPY	C.R. POST THERAPY	T°C PRE THERAPY	T°C POST THERAPY
SHORT WAVE	1.	330	265	270	29.5	34.0	32.0	330	290	29.5	31.0
	2.	310	260	260	30.0	34.0	32.0	310	280	30.0	31.5
	3.	325	290	325	31.0	33.0	31.5	350	315	31.5	33.0
	4.	380	325	370	30.0	33.0	31.5	400	380	30.0	30.5
	5.	350	320	330	31.0	34.0	33.0	350	340	32.0	32.5
	6.	315	250	250	30.0	34.5	33.0	315	285	30.0	31.5
	7.	330	250	250	30.0	34.0	33.0	330	265	30.0	32.0
	8.	330	240	245	32.5	35.0	34.0	330	285	32.0	32.5
	9.	330	265	330	32.0	34.5	32.0	330	275	32.0	33.5
	10.	325	255	295	30.0	32.5	31.5	325	285	30.0	31.0
MICRO WAVE	1.	330	300	310	30.0	32.5	31.5	330	310	30.5	31.0
	2.	310	310	310	30.0	31.0	30.0	310	310	30.0	30.5
	3.	325	295	305	31.5	34.5	33.0	350	330	31.5	31.5
	4.	380	350	380	29.5	32.0	30.5	400	400	28.5	29.5
	5.	350	325	350	32.5	34.5	33.5	350	350	31.5	32.0
	6.	315	285	315	30.0	32.0	30.0	315	305	30.0	31.0
	7.	330	330	330	30.0	32.5	30.0	330	330	30.0	30.0
	8.	330	310	330	32.5	33.5	32.5	330	330	32.5	32.5
	9.	330	310	310	32.0	34.0	33.0	330	320	32.0	33.0
	10.	325	290	320	29.5	32.0	30.5	325	305	30.0	31.0
SOLLUX	1.	330	225	225	29.5	34.5	31.5	330	320	30.5	30.5
	2.	310	220	235	28.0	34.0	31.5	310	295	28.5	28.5
	3.	325	285	295	31.5	32.0	31.5	350	350	31.5	31.5
	4.	380	310	330	28.5	31.5	29.5	400	400	28.0	28.0
	5.	350	260	270	30.0	35.0	32.0	350	350	31.0	31.0
	6.	315	250	285	30.0	35.5	31.5	315	315	30.5	30.0
	7.	330	240	240	30.0	35.0	33.5	330	330	30.0	29.5
	8.	330	260	290	32.0	34.5	33.0	330	330	32.0	32.0
	9.	330	255	265	31.0	34.5	33.0	330	330	31.0	31.0
	10.	325	245	245	31.0	34.5	32.5	325	305	30.0	30.0
FANGO	1.	330	230	230	31.0	35.0	34.0	330	305	29.0	30.0
	2.	310	215	225	30.0	34.0	31.5	310	295	30.0	31.0
	3.	325	260	260	31.5	33.5	33.5	350	325	31.5	32.5
	4.	380	300	300	28.0	33.0	32.0	400	365	28.5	31.0
	5.	350	290	300	31.0	33.0	33.0	350	330	30.5	31.0
	6.	315	190	200	30.0	34.5	32.5	315	285	30.0	30.0
	7.	330	225	225	30.5	33.0	33.0	330	300	30.5	31.5
	8.	330	215	215	31.5	35.0	33.0	330	300	31.5	32.5
	9.	330	255	265	30.5	34.5	33.0	330	305	30.0	32.0
	10.	325	240	240	30.5	34.5	33.5	325	295	30.0	32.0
HOT AIR	1.	330	250	255	29.0	35.0	32.0	330	290	30.0	30.0
	2.	310	235	250	29.5	35.0	33.0	310	265	29.5	31.0
	3.	325	265	265	30.5	32.5	32.0	350	310	31.5	31.5
	4.	380	305	305	28.0	33.5	32.5	400	360	29.0	30.5
	5.	350	285	295	32.0	35.5	33.0	350	295	32.5	32.5
	6.	315	235	235	30.5	35.0	34.5	315	260	30.5	31.0
	7.	330	245	260	30.5	35.0	33.0	330	310	31.0	30.5
	8.	330	250	250	32.0	34.0	33.5	330	275	32.0	32.5
	9.	330	245	250	31.0	34.5	34.0	330	275	31.5	32.0
	10.	325	240	240	30.0	35.5	33.0	325	295	30.5	32.0

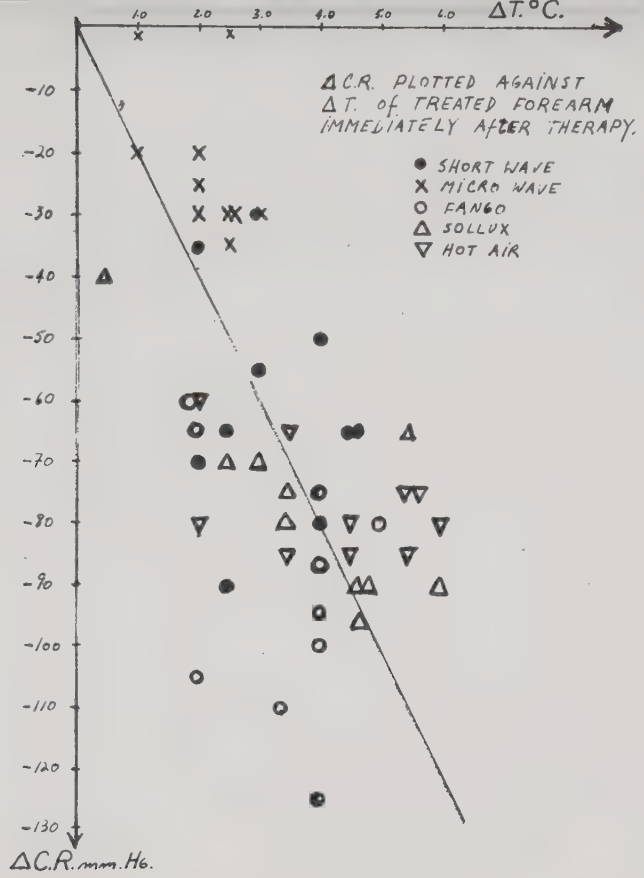
	SHORT WAVE 19 V., 2.5 AMP., 10'						MICRO WAVE 70% POWER, 10', 10cm. DISTANCE.						FANGO 20'					
	I		II		III		I		II		III		I		II		III	
PT.	C.R.	T.	C.R.	T.	C.R.	T.	C.R.	T.	C.R.	T.	C.R.	T.	C.R.	T.	C.R.	T.	C.R.	T.
1.	65	4.5	40	1.5	60	2.5	30	2.5	20	0.5	20	1.5	100	4.0	25	1.0	100	3.0
2.	50	4.0	30	1.5	50	2.0	0	1.0	0	0.5	0	0.0	95	4.0	15	1.0	85	1.5
3.	35	2.0	35	1.5	10	0.5	30	3.0	20	0.0	20	1.5	65	2.0	25	1.0	65	2.0
4.	55	3.0	20	0.5	20	1.5	30	2.5	0	1.0	0	1.0	80	5.0	35	2.5	80	4.0
5.	30	3.0	10	0.5	20	2.0	25	2.0	0	0.5	0	1.0	60	2.0	20	0.5	50	2.0
6.	65	4.5	30	1.5	65	3.0	30	2.0	10	1.0	0	0.0	125	4.5	30	0.0	115	2.5
7.	80	4.0	65	2.0	80	3.0	0	2.5	0	0.0	0	0.0	105	2.5	30	1.0	105	2.5
8.	90	2.5	40	2.5	85	1.5	20	1.0	0	0.5	0	0.0	110	3.5	30	1.0	110	3.5
9.	65	2.5	55	1.5	0	0.0	20	2.0	10	1.0	20	1.0	75	4.0	25	2.0	65	2.5
10.	70	2.5	40	1.0	30	1.5	35	2.5	20	1.0	5	1.0	85	4.0	30	2.0	85	3.0
RANGE of RESULTS	30-90	20-4.5	10-65	0.5-3.5	0-85	0.0-3.0	0-35	1.0-3.0	0-30	0.0→1.0	0-30	0.0-1.5	60-125	2.0-5.0	15-35	0.0-2.5	50-115	1.5-4.0
AVERAGE	61	3.3	37	1.4	42	1.8	22	2.0	8	0.6	6.5	0.7	90	3.6	27.5	1.2	86	2.7
Δ C.R. mm. Hg PRO 1°C.	18.5		26		23		11		15		9		25		23		32	

	SOLLUX RED FILTER, 10', 10cm. DISTANCE						HOT AIR 70-80°C., 15'.					
	I		II		III		I		II		III	
PT.	C.R.	T.	C.R.	T.	C.R.	T.	C.R.	T.	C.R.	T.	C.R.	T.
1.	95	5.0	10	0.0	95	2.0	80	6.0	40	0.0	75	3.0
2.	90	6.0	15	0.0	75	3.5	75	5.5	45	1.5	60	3.5
3.	40	0.5	0	0.0	30	0.0	60	2.0	40	0.0	60	1.5
4.	70	3.0	0	0.0	50	1.0	75	5.5	40	1.5	75	4.5
5.	90	5.0	0	0.0	80	2.0	65	3.5	55	0.0	55	1.0
6.	65	5.5	0	-0.5	30	1.5	80	4.5	55	0.5	80	4.0
7.	90	5.0	0	-0.5	90	3.5	85	4.5	20	-0.5	70	2.5
8.	70	2.5	0	0.0	40	1.0	80	2.0	55	0.5	80	1.5
9.	75	3.5	0	0.0	65	2.0	85	3.5	65	0.5	80	3.0
10.	80	3.5	20	0.0	80	1.5	85	5.5	30	1.5	85	3.0
RANGE of RESULTS	40-95	0.5-6.0	0-20 / -0.5-0.0	-0.5-0.0 / 3.0-3.5	30-95	0.0-3.5	65-85	2.0-6.0	20-55	-0.5-1.5	55-85	1.0-4.5
AVERAGE	75	4.0	4.5	0	64	1.8	77	4.3	44	0.6	72	2.8
Δ C.R. mm. Hg PRO 1°C.	19		—		36		18		73		26	

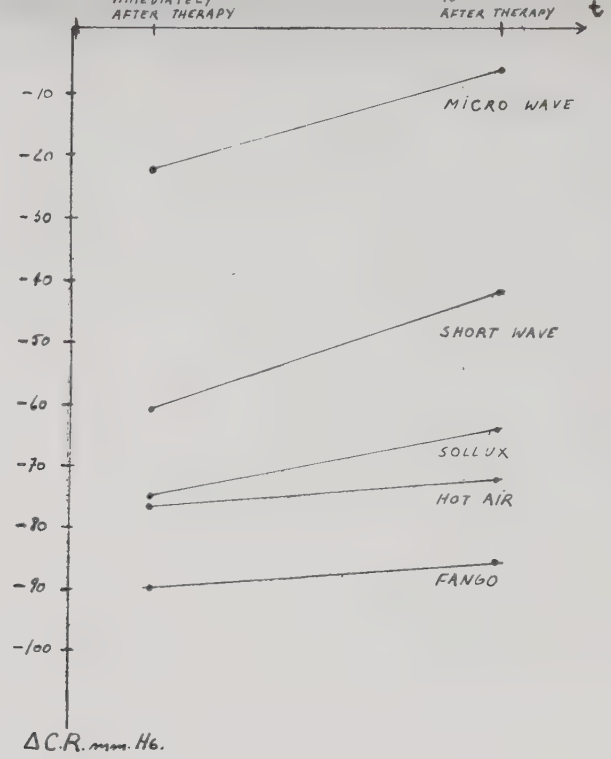
COLUMN I = Δ C.R. mm. Hg + Δ T.°C. IMMEDIATELY AFTER THERAPY ON TREATED FOREARM.

COLUMN II = Δ C.R. mm. Hg + Δ T.°C. IMMEDIATELY AFTER THERAPY ON UNTREATED FOREARM.

COLUMN III = Δ C.R. mm. Hg + Δ T.°C. 10' AFTER THERAPY ON TREATED FOREARM.



GRAPH # 1



GRAPH # 2

pro 1° C. readings, immediately and ten minutes after therapy, we find that in all cases the Δ C. R. pro 1° C. has increased even though the temperature and hyperemia decreased.

	SHORT WAVE	FANGO	SOLLUX	HOT AIR
Δ C.R. mm. Hg. pro 1°C. IMMEDIATELY AFTER TREATMENT	18.5	25	19	18
10' AFTER TREATMENT	23	32	36	26

This definitely indicates a specific change in the permeability of the capillary wall.

In the future, it would be of further interest to study the effects produced on the C. R. by balneological and other physical therapeutic methods.

SUMMARY

The effect of various physical therapeutic measures (short and micro waves, Fango, Sollux and hot air), on the C. R. was studied.

We found that the C. R. was only slightly decreased by micro waves (corresponding to the decrease produced by purely physical means), but greatly decreased by the four other methods (corresponding to the effect of circulatory drugs, e. g. Histamine.)

Our experiments show that the change in the C. R. immediately after treatment is a function of the change in skin temperature, whereas, the changes recorded ten minutes later are a function of the initial intensity of C. R. change. The

The rise in C. R. after ten minutes is inversely proportional to the initial C. R. change.

The various changes on the C. R. by the different treatments appear to be due to the following:

1. Purely physical effects.
2. Direct effect on the permeability of the capillary wall.
3. Vasodilation due to the liberation of histamine, or histamine-like substances.
4. Direct nervous stimuli and reflexly to the corresponding dermatome.

By means of these C. R. measurements we were able to gain some insight into the quantitative changes produced in the vascular system by some of our physical therapeutic methods currently in use.

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ZUSAMMENFASSUNG:

1. Zweck der Untersuchungen

Die vorliegenden Untersuchungen befassen sich mit der Frage in welcher Weise die Kapillarresistenz durch die verschiedenen trockenen Wärme-Therapien beeinflusst wird. Auf Grund der Untersuchungen von Knoll, Milbrandt und Wyss war zwar stets mit einer Senkung der Kapillarresistenz zu rechnen. Uns interessieren jedoch die quantitativen Verhältnisse und die Unterschiede zwischen den einzelnen Massnahmen.

Zur Anwendung gelangten Wärmestrahlen (Solluxlampe), Parafangopackungen (Mischung von Fango mit Paraffin), Mikrowellen (Radar), Kurzwellen sowie Heissluft. Bei all diesen Massnahmen entsteht eine Ueberwärmung der Haut und der darunter liegenden Gewebe, wobei sich jedoch das Maximum der Erwärmung je nach der Art der Wärme an verschiedenen Stellen lokalisiert. Bei der Anwendung von Heissluft und Parafango liegt das Erwärmungsmaximum an der Hautoberfläche, weil hier die Wärme fast ausschliesslich durch Leitung dem Körper zugeführt wird. Bei Wärmestrahlung, sowie Mikro- und Kurzwellenbehandlung kommt es durch Absorption von elektromagnetischer Energie oder durch innere Reibung infolge Jonenverschiebung (Joulesche Wärme) zur Wärmeentwicklung in den Geweben selbst, d. h. unterhalb der Körperoberfläche. So führt die Kurzwellendurchflutung in den gut leitenden Körpergeweben zu einer homogenen Wärmeverteilung, von der nur die schlechten Leiter (Stratum corneum, Fettgewebe, Knochen) ausgenommen sind, sodass sich kein eigentliches Erwärmungsmaximum ausbilden kann. Bei den Mikrowellen findet sich dagegen ein soclches in der Tiefe von 2-3 cm., und bei der Wärmestrahlung (sichtbare und kurzwellige Infrarotstrahlung) lokalisiert sich dasselbe in das Stratum papillare des Corium.

Die Unterschiede sind von grosser Bedeutung, wil nach Untersuchungen von Goldscheider[13] das Wärmegefälle der Haut verantwortlich sein soll für die Wärmeempfindung und die dazugehörige vasomotorische Reaktion. Diese verändert sich bei Wärmezufuhr von aussen, jedoch ganz verschieden je nach der Lage des Erwärmungsmaximums, Bestehen die Goldscheiderschen Auffassungen zu Recht, dann müssen sich bei den Massnahmen, bei denen das Erwärmungsmaximum oberflächlich liegt (Heissluft, Parafangopackung, Wärmestrahlung), die grössten Veränderungen der Kapillarresistenz ergeben.

2. Versuchsbedingungen:

Die oben genannten trockenen Erwärmungsverfahren wurden bei 10 gesunden Versuchspersonen jeweils am linken Vorderarm angewandt. Vor der Wärmeapplikation, sofort nachher, sowie 10 Minuten später erfolgte die Messung der Kapillarresistenz und der Hauttemperatur beidseitig an der den Ellbogen benachbarten Innenflache des Vorderarms. Die Kapillarresistenz bestimmten wir mit Hilfe des von F. Wyss entwickelten Saugglockenverfahrens (Apparat Junghans), die Hauttemperatur mit dem Hautthermometer nach Heidenwolf.

3. Ergebnisse:

Bei den meisten Versuchen zeigte sich die erwartete Herabsetzung der Kapillarresistenz. Die Stärke der Veränderungen liess sich in nachstehender Reihenfolge feststellen: Die grössten Veränderungen wurden nach Parafangopackungen nachgewiesen, darauf folgten die Veränderungen durch Heissluft, durch Wärmestrahlen (Solluxlampe), durch Kurzwellen und schliesslich durch Mikrowellen, wo kaum mehr eine Veränderung feststellbar war, obgleich es auch bei diesen zu einer Erhöhung der Haut-

temperatur kam. Die oberflächlich wirkenden Wärmeprozeduren verursachten somit die stärksten Veränderungen der Kapillarresistenz, was mit den Auffassungen von Goldscheider über die physiologische Bedeutung des Wärmegefälles in der Haut durchaus übereinstimmt.

Unsere Versuche mit den verschiedenen Massnahmen mit Ausnahme der Mikrowellen zeigten, dass die Veränderungen in der Kapillarresistenz (sofort nach der Behandlung) eine Funktion der Hauttemperaturveränderung ist. Wir haben festgestellt, dass die durchschnittliche Veränderung der Kapillaresistenz eine Verminderung von 20-30 mm Hg. pro 1 Grad Celsius Hauttemperaturerhöhung ergibt. Dieses entspricht den Veränderungen erzeugt durch kreislaufwirkende Substanzen wie z.B. Histamine wie festgestellt durch H. Knoll, W. Wilbrandt und F. Wyss. (1)

Interessanterweise liessen sich auch am unbehandelten rechten Arm sehr oft Veränderungen der Kapillarresistenz sowie der Hauttemperatur nachweisen. Es zeigte dies erneut, dass sich die Wirkung von Wärmemassnahmen über den Ort der direkten Wärmeeinwirkung ausbreiten kann, sei es auf dem Weg der Irradiation autonomer Reflexe oder durch Ausschwemmung vasoaktiver Substanzen. In der Balneologie sind solche Erscheinungen seit langem bekannt und werden als sogenannte konsensuelle Reaktion bezeichnet. Merkwürdigerweise verhält sich diese nicht analog zu den primären Veränderungen am behandelten Arm. Die grösste konsensuelle Reaktion beldete sich in unseren Versuchen nach der Heissluftanwendung, es folgte diejenige nach Kurzwellenbehandlung und Parafangopackungen und erst in grossem Abstand diejenige nach Mikrowellenbehandlung und Wärmestrahlen, bei welchen praktisch von einem Fehlen der konsensuellen Reaktion

gesprochen werden konnte. Dies ist umso auffallender, weil die Wärmestrahlen am Orte ihrer direkten Einwirkung eine starke Veränderung der Kapillarresistenz und der Hauttemperatur verursachten.

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